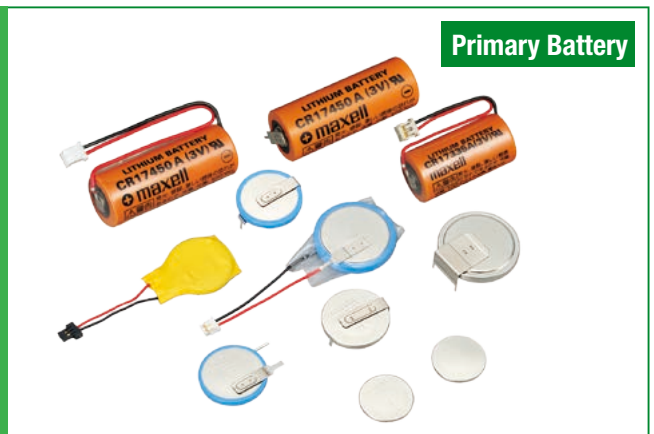


CR

Lithium Manganese Dioxide Battery (Li/MnO₂)



LITHIUM MANGANESE DIOXIDE BATTERY

Safety Instructions

This battery contains lithium, organic solvents, and other combustible materials. For this reason, improper handling of the battery could lead to distortion, leakage*, overheating, explosion, or fire, causing bodily injury or equipment trouble. Please observe the following instructions to prevent accidents.

(* Leakage is defined as the unintentional escape of a liquid from a battery.)

⚠ Warnings — Handling

■ Never swallow.

Always keep the battery out of the reach of infants and young children to prevent it from being swallowed. If swallowed, consult a physician immediately.

■ Never charge.

The battery is not designed to be charged by any other electrical source. Charging could generate gas and internal short-circuiting, leading to distortion, leakage, overheating, explosion, or fire.

■ Never heat.

Heating the battery to more than 100 deg. C* could increase the internal pressure, causing distortion, leakage, overheating, explosion, or fire. (* Consult Maxell regarding heat resistant coin type lithium manganese dioxide batteries.)

■ Never expose to open flames.

Exposing to flames could cause the lithium metal to melt, causing the battery to catch on fire and explode.

■ Never disassemble the battery.

Do not disassemble the battery, because the separator or gasket could be damaged, leading to distortion, leakage, overheating, explosion, or fire.

■ Never reverse the positive and negative terminals when mounting.

Improper mounting of the battery could lead to short-circuiting, charging or forced-discharging. This could cause distortion, leakage, overheating, explosion, or fire.

■ Never short-circuit the battery.

Do not allow the positive and negative terminals to short-circuit. Never carry or store the battery with metal objects such as a necklace or a hairpin. Do not take multiple batteries out of the package and pile or mix them when storing. Otherwise, this could lead to distortion, leakage, overheating, explosion, or fire.

■ Never weld the terminals or weld a wire to the body of the battery directly.

The heat of welding or soldering could cause the lithium to melt, or cause damage to the insulating material in the battery. This could cause distortion, leakage, overheating, explosion, or fire. When soldering the battery directly to equipment, solder only the tabs or leads. Even then, the temperature of the soldering iron must be below 350 deg. C and the soldering time less than 5 seconds. Do not use a soldering bath, because the circuit board with battery attached could stop moving or the battery could drop into the bath. Moreover do not use excessive solder, because the solder could flow to unwanted portions of the board, leading to a short-circuit or charging of the battery.

■ Never use different batteries together.

Using different batteries together, i.e. different type or used and new or different manufacturer could cause distortion, leakage, overheating, explosion, or fire because of the differences in battery property. If using two or more batteries connected in series or in parallel even same batteries, please consult with Maxell before using.

■ Never allow liquid leaking from the battery to get in your eyes or mouth.

Because this liquid could cause serious damage, if it does come in contact with your eyes, flush them immediately with plenty of water and consult a physician. Likewise, if the liquid gets in your mouth, rinse immediately with plenty of water and consult a physician.

■ Keep leaking batteries away from fire.

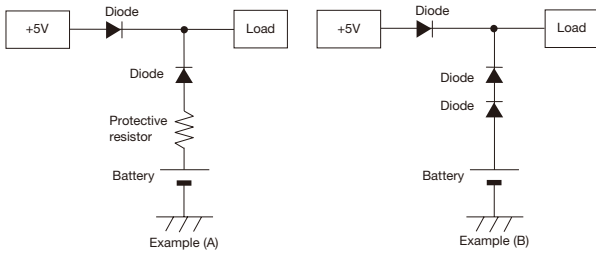
If leakage is suspected or you detect a strong odor, keep the battery away from fire, because the leaked liquid could catch on fire.

■ Never touch the battery electrodes.

Do not allow the battery electrodes to come in contact with your skin or fingers. Otherwise, the moisture from your skin could cause a discharge of the battery, which could produce certain chemical substances causing you to receive a chemical burns.

Warnings — Circuit Design for Back-up Use

This is a primary battery and cannot be charged. If used in memory or RTC back-up applications, be sure to use diodes to prevent charging from the main power source or other batteries, and a protective resistor to regulate the current as shown in the figure below. Note that the points described below should be taken into careful consideration when selecting diodes and protective resistors.



Supplied voltage to load

Because a diode and a resistor generate the voltage drop on operating, please take into consideration these voltage drops for supplied voltage to load.

Using diodes to prevent charging

Please choose diodes with leak current as small as possible. Please keep the charged capacity due to leak current to within 1% of nominal capacity.

Using and setting protective resistors

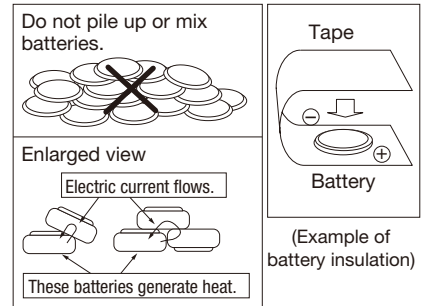
A protective resistor is used to prevent the battery from being charged by large surges of current during diode failure. Please set the resistor so that the maximum current shown in the right table is not exceeded. For example, say a CR2032 battery is used in sample circuit (A) in combination with a main power source 5 volt. Since the permitted charge current is 10mA and this battery's voltage is 3V, let the resistor be $R \geq (5V-3V)/10mA=0.2k \text{ ohm}$, meaning that at least 0.2k ohm is required.

Type	Maximum Current
CR2450HR	15mA
CR2450HR-Ex	15mA
CR2050HR	10mA
CR2450	15mA
CR2430	15mA
CR2032H	10mA
CR2032	10mA
CR2025	10mA
CR2016	10mA
CR1632	4.0mA
CR1620	4.0mA
CR1616	2.5mA
CR1220	3.0mA
CR1216	2.5mA
CR17450 A	20mA
CR17335 A	20mA

Note: If the diodes broke down, it is necessary for safety to replace them as soon as possible even though using a protective resistor. Considering the trouble of diodes and resistors, other safety measures should be incorporated in the circuit design.

Warnings — Disposal

The battery may be regulated by national or local regulation. Please follow the instructions of proper regulation. As electric capacity is left in a discarded battery and it comes into contact with other metals, it could lead to distortion, leakage, overheating, or explosion, so make sure to cover the (+) and (-) terminals with friction tape or some other insulator before disposal.



Caution — Handling/Storage

Never expose the battery to ultrasonic sound.

Exposing the battery to ultrasonic sound may cause short-circuiting because the inside material is broken into pieces, leading to distortion, leakage, overheating, explosion, or fire.

Never subject the battery to severe shock.

Dropping, throwing or stomping on the battery may cause distortion, leakage, overheating, explosion, or fire.

Never short-circuit the battery while installing into equipment.

Please be careful when installing the battery not to short-circuit it with metal portions of the equipment.

Use the correct battery suitable for the equipment.

The battery may not be suitable for the specific equipment due to the using conditions or type of equipment. Please select the suitable battery according to the handling instructions of the equipment.

Never use or leave the battery in a hot place such as under the direct rays of the sun or in a car in hot weather.

If you do, this may cause distortion, leakage, overheating, explosion, or fire.

Never allow the battery to come in contact with water.

If it does, this may cause the battery to rust or lead to distortion, leakage, overheating, explosion, or fire.

Never store the battery in a hot and highly humid environment.

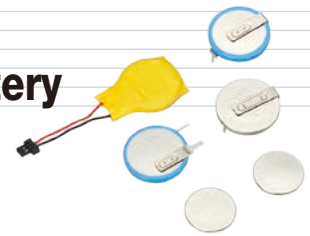
Doing so may cause the performance of the battery to deteriorate. In certain environments, this may lead to distortion, leakage, overheating, explosion, or fire.

Keep contact pressure more than 2N.

The battery voltage may be lower than intended value because of poor contact condition, please keep contact pressure more than 2N for suitable contact resistance.

CR

Coin Type Lithium Manganese Dioxide Battery



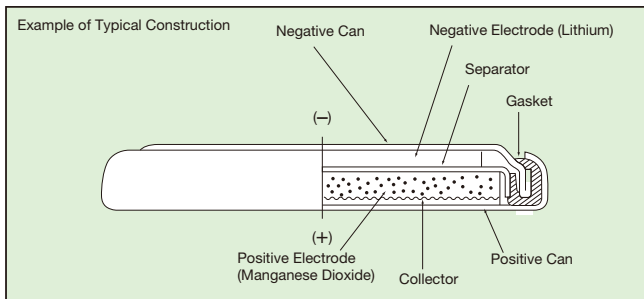
Overview

The coin type lithium manganese dioxide battery (CR battery) is a small, lightweight battery with an operating voltage of 3V and the ability to operate over a wide temperature range. It has a wide range of applications, both for powering devices such as wristwatches and electronic calculators and can be used in all types of electronic devices mainly as memory and RTC backup.

Features

- Optimum for Memory and RTC Backup (Fig. 1)**
 Displays long-term stable operating voltage at low load discharge.
- High 3 volt energy density**
 High energy density. At 3 volts (nominal voltage), it has about twice the voltage of alkaline button batteries and silver oxide batteries.
- Stable discharge characteristics through low internal resistance and high operating voltage**
 Employs highly conductive electrolyte, lowering internal resistance and providing stable operating voltage. This allows stable power to be obtained, with little change in operating voltage at room temperature as well as high and low temperatures.
- Superior leakage resistance and excellent storage characteristics (Fig. 2)**
 Employs a leak-resistant organic electrolyte, giving it better leakage resistance than battery types using alkaline electrolytes. Furthermore, the high degree of seal of the seal structure and application of sealant keep self-discharge to about 1% per year.
- Superior high rate discharge characteristics**

Construction



Principle and Reactions

The coin type lithium manganese dioxide battery uses manganese dioxide (MnO₂) as its positive active material, lithium (Li) as its negative active material, and an organic electrolyte solution.

Battery reactions

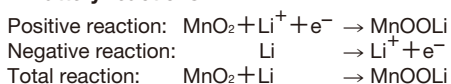


Fig. 1 Relationship between Discharge Current Consumption and Duration Time

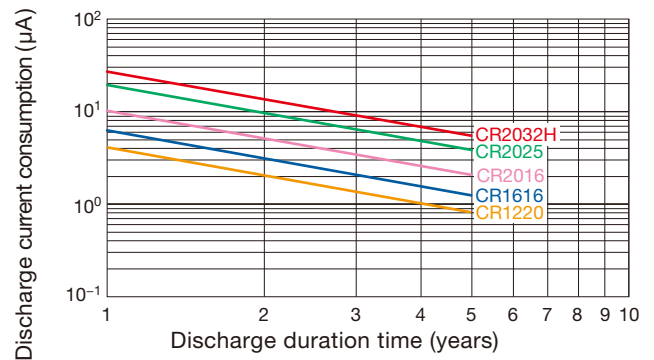
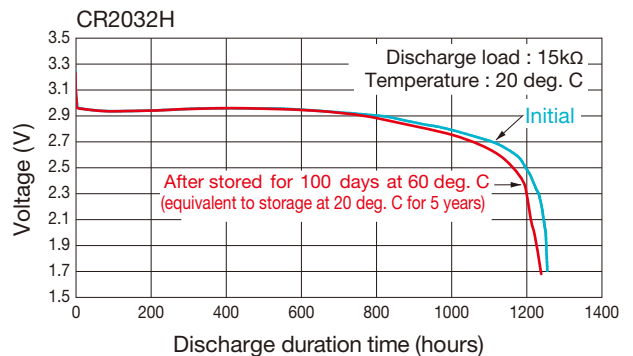


Fig. 2 Discharge Characteristics after Storage



UL Recognized Components

The coin type lithium manganese dioxide battery is a UL (Underwriters Laboratories Inc.) recognized component and user replaceable.

Recognized models:

CR2032H, CR2032, CR2025, CR2016, CR1632, CR1620, CR1616, CR1220, CR1216

Certification Number: MH12568

Applications

- Communication Tags
- OA Machines (Fax, Copiers, Printers)
- Digital Still Cameras
- Medical Instruments, Cash Registers
- Electronic Meters (Water, Gas, Electricity)
- FA Instruments (Measuring Instruments, Onboard Microcomputers, Sensors)
- Notebook PCs
- Electronic Dictionaries
- Camcorders
- Keyless Entry Systems
- Remote Controllers
- Desktop PCs
- Calculators
- Watches
- Portable Game Devices

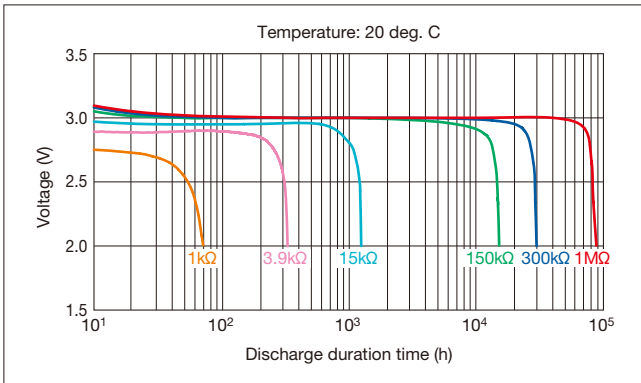
Products

Model	CR2032H	CR2032	CR2025	CR2016	CR1632	CR1620	CR1616	CR1220	CR1216	
Nominal Voltage (V)	3	3	3	3	3	3	3	3	3	
Nominal Capacity (mAh)**	240	220	170	90	140	80	55	36	25	
Nominal Discharge Current (mA)	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	
Operating Temperature Range (deg. C)***	-20 to +85									
Dimensions*	Diameter (mm)	20.0	20.0	20.0	20.0	16.0	16.0	16.0	12.5	12.5
	Height (mm)	3.2	3.2	2.5	1.6	3.2	2.0	1.6	2.0	1.6
Weight (g)*	3.0	3.0	2.5	1.7	1.9	1.3	1.1	0.8	0.6	

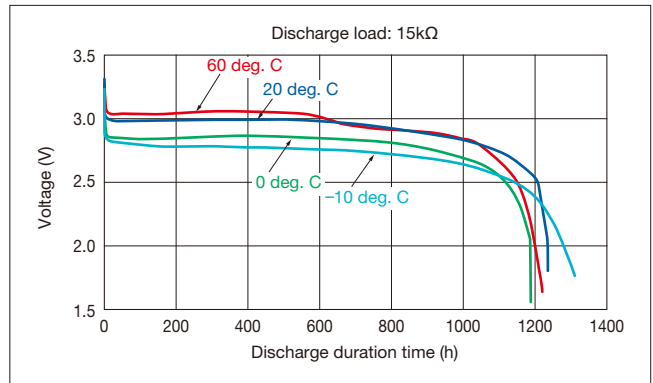
* Dimensions and weight are for the battery itself, but may vary depending on terminal specifications and other factors.
 ** Nominal capacity indicates duration until the voltage drops down to 2.0V when discharged at a nominal discharge current at 20 deg. C.
 *** When using these batteries at temperatures outside the range of 0 to +40 deg. C, please consult Maxell in advance for conditions of use.
 • Data and dimensions are just reference values. For further details, please contact your nearest Maxell dealer or distributor.

Characteristics (CR2032H)

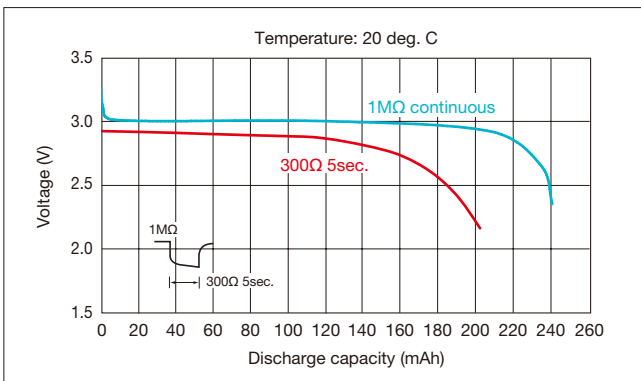
Discharge Characteristics



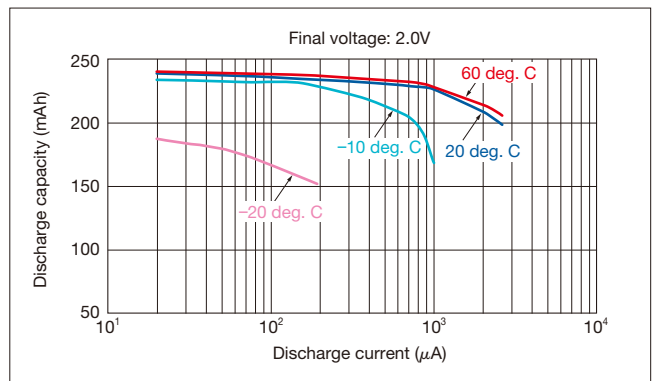
Temperature Characteristics



Pulse Discharge Characteristics



Relationship between Discharge Current and Discharge Capacity



C R

External Dimensions with Terminals and Wire Connectors (unit : mm)

CR2032 T6	CR2032 T6LES	CR2032 T19	CR2032 T23
CR2032 T33	CR2032 T26	CR2032 T34	CR2032 WK11
			<p>Insulation sleeve</p> <p>Adhesive tape</p> <p>Lead wire</p> <p>Housing: DF13-2S-1.25C (Hirose) Contact: DF13-2630SCF (Hirose) Wire: AWG28 UL1571</p>
CR2032 WK12	CR2032 WK13	CR2032 WK14	CR2032 WK15
<p>Insulation sleeve</p> <p>Adhesive tape</p> <p>Lead wire</p> <p>Housing: DF13-2S-1.25C (Hirose) Contact: DF13-2630SCF (Hirose) Wire: AWG28 UL1571</p>	<p>Insulation sleeve</p> <p>Adhesive tape</p> <p>Lead wire</p> <p>Housing: DF13-2S-1.25C (Hirose) Contact: DF13-2630SCF (Hirose) Wire: AWG28 UL1571</p>	<p>Insulation sleeve</p> <p>Lead wire</p> <p>Housing: DF3-4S-2C (Hirose) Contact: DF3-2428SCF (Hirose) Wire: AWG26 UL1007</p>	<p>Insulation sleeve</p> <p>Adhesive tape</p> <p>Lead wire</p> <p>Housing: DF13-2S-1.25C (Hirose) Contact: DF13-2630SCF (Hirose) Wire: AWG28 UL1571</p>

The above are examples. Processing to meet customer requests is possible.

- : Horizontal & Through hole Type
- : Horizontal & Surface mounting Type
- : Vertical & Through hole Type
- : Wire connector Type

: Tin plating

Visit our website for more information

<http://biz.maxell.com/en/>

Go to: Products > Primary Batteries > CR (Coin Type Lithium Manganese Dioxide Battery)

Dangerous Goods Transportation Regulations for Lithium Cells and Batteries

Some transportation regulations have been recently revised and will come into effect after Jan. 1, 2015. The summary is shown in the following table. Please use updated Dangerous Goods Regulations listed in Normative Reference to confirm details.








■ The major revisions for air transport of lithium cells and batteries

(1) Lithium metal cells and batteries transported as cargo will be restricted to cargo aircraft only.

Note. The prohibition does not apply to lithium metal batteries packed with equipment (PI 969) or contained in equipment (PI 970).

(2) Gross mass will change to net quantity for both lithium ion cells and batteries (PI 965 Section IB) and lithium metal cells and batteries (PI 968 Section IB)

Technical instructions for lithium metal batteries (PI 968)

Section	Section II		Section IB	Section IA	
Lithium Metal Content	Cell: ≤ 0.3 g Battery: ≤ 0.3 g	Cell: ≤ 1.0 g Battery: ≤ 2.0 g	Cell: ≤ 1.0 g Battery: ≤ 2.0 g	Cell: > 1.0 g Battery: > 2.0 g	
Package Limits	Quantity	N/A	≤ 2 batteries or ≤ 8 cells	> 2 batteries or > 8 cells	N/A
	Net Weight	Cargo aircraft only 2.5 kg	Cargo aircraft only N/A	Cargo aircraft only 2.5 kg	Cargo aircraft only 35 kg
Classification	Exempted		Class 9		
Packaging	Strong outer packaging 1.2 M drop test			UN performance packaging	
Labels	 Note 1)	 Note 2)	 Note 3)	   	
Documents	Invoice (air waybill)* Additional documents***		Declaration for DG Air waybill** Additional documents***	Declaration for DG Air waybill**	
Training	Adequate instructions		DG training		

Note 1): Handling label Note 2): Cargo aircraft only label (necessary for lithium metal cells and batteries)

Note 3): Class 9 hazardous label

* The words "lithium metal batteries, in compliance with Section II of PI 968" and "Cargo Aircraft Only" or "CAO" must appear on the air waybill, when an air waybill is used. This description should appear in the "Nature and Quantity of Goods" box.





** The words "Dangerous Goods as per attached Shipper's Declaration" and "Cargo Aircraft Only" or "CAO" must appear in the air waybill's "Handling Information" column.

*** Additional documents must indicate:

- The package contains lithium metal cells or batteries;
- The package must be handled with care and that a flammability hazard exists if the package is damaged;
- Special procedures should be followed in the event the package is damaged, to include inspection and repacking if necessary; and
- A telephone number for additional information.

This information can be written in the Declaration for DG's "Additional Handling Information" column or on the air waybill.

Technical instructions for lithium-ion batteries (PI 965)

Section		Section II		Section IB	Section IA
Watt hour		Cell: ≤ 2.7 Wh Battery: ≤ 2.7 Wh	Cell: ≤ 20 Wh Battery: ≤ 100 Wh	Cell: ≤ 20 Wh Battery: ≤ 100 Wh	Cell: > 20 Wh Battery: > 100 Wh
Package Limits	Quantity	N/A	≤ 2 batteries or ≤ 8 cells	> 2 batteries or > 8 cells	N/A
	Net Weight	2.5 kg	N/A	10 kg Passenger and cargo aircraft	5 kg: Passenger aircraft 35 kg: Cargo aircraft
Classification		Exempted		Class 9	
Packaging		Strong outer packaging 1.2 M drop test			UN performance packaging
Labels					
Documents		Invoice (air waybill)* Additional documents***		Declaration for DG Air waybill** Additional documents***	Declaration for DG Air waybill**
Training		Adequate instructions		DG training	

* The words "Lithium ion batteries in compliance with section II of PI 965" must appear in the air waybill's "Nature and Quantity of Goods" box, when an air waybill is used. The words "Cargo Aircraft Only" or "CAO" must appear on the air waybill, when transported by cargo.

** The words "Dangerous Goods as per attached Shipper's Declaration" must appear in the air waybill's "Handling Information" column. The words "Cargo Aircraft Only" or "CAO" must appear on the air waybill, when transported by cargo.

*** Additional documents must indicate:

- The package contains lithium ion cells or batteries;
- The package must be handled with care and that a flammability hazard exists if the package is damaged;
- Special procedures should be followed in the event the package is damaged, to include inspection and repacking if necessary; and
- A telephone number for additional information.

This information can be written in the Declaration for DG's "Additional Handling Information" column or on the air waybill.

■ The major revisions for UN Model Regulations 18th Revised Edition

- (1) Damaged or defective cells or batteries shall be transported as "Class 9" hazardous goods according to Special Provision 376 and Packing Instruction P908 or LP904.
- (2) Cells and batteries transported for disposal or recycling shall be transported as "Class 9" hazardous goods according to Special Provision 377 and Packing Instruction P909.

The IMDG Code 2014 edition will contain the descriptions of these UN recommendations. The voluntary compliance date is Jan. 1, 2015. Compliance becomes mandatory on Jan. 1, 2016.

Although these revisions will be reflected in each country's regulations, some districts, countries or airlines may establish their own special requirements. Therefore the shipper shall confirm with the forwarder in advance.

Reference

Except for air transportation, the necessary requirements to transport lithium metal batteries or lithium-ion batteries as exempted from regulation (non-restricted goods) are as follows;

1. The minimum requirements to transport lithium metal batteries as non-restricted goods are as follows;

- a) Cells and batteries shall be manufactured under a quality management program.
- b) For a lithium metal or a lithium alloy cell, the lithium content must not be more than 1 g.
For a lithium metal or lithium alloy battery, the aggregate lithium content must not be more than 2 g.
- c) Each cell or battery must be of the type proven to meet the requirements of each test in the UN Manual of Tests and Criteria, 5th revised edition, Part III, sub-section 38.3.
- d) A battery handling label must be displayed on each package. A telephone number must be printed on the label for additional information.
- e) Each consignment must be accompanied by a document for transport with an indication that:
 - the package contains lithium metal cells or batteries;
 - the package must be handled with care and that a flammability hazard exists if the package is damaged;
 - special procedures should be followed in the event that the package is damaged, to include inspection and repackaging if necessary; and
 - a telephone number for additional information.
- f) Each package must be capable of withstanding a 1.2 m drop test.
- g) Except when batteries are installed in or packed with equipment, packages shall not exceed 30 kg gross mass.

2. The minimum requirements to transport the lithium-ion batteries as non-restricted goods are as follows;

- a) Cells and batteries shall be manufactured under a quality management program.
- b) For lithium-ion cells, the Watt-hour rating is not more than 20 Wh. For lithium-ion batteries, the Watt-hour rating is not more than 100 Wh. The Watt-hour rating must be marked on the outside of the battery case except for those manufactured before Jan. 1, 2009.
- c) Each cell or battery is of the type proven to meet the requirement of each test in the UN Manual of Tests and Criteria, 5th revised edition, Part III, sub-section 38.3.
- d) A battery handling label must be displayed on each package. A telephone number must be printed on the label for additional information.
- e) Each consignment must be accompanied by a document for transport with an indication that:
 - the package contains lithium-ion cells or batteries;
 - the package must be handled with care and that a flammability hazard exists if the package is damaged;
 - special procedures should be followed in the event the package is damaged, to include inspection and repackaging if necessary; and
 - a telephone number for additional information.
- f) Each package must be capable of withstanding a 1.2 m drop test.
- g) Except when batteries are installed in or packed with equipment, packages shall not exceed 30 kg gross mass.

Maxell will provide certificates for b) and c) as the need arises. Documentation for d) and e) needs to be prepared by the customer. If our package is used for transport, Maxell will provide the certificate for f) as the need arises. However, if the customer's package is used, the customer must confirm the package can withstand a 1.2 m drop test. Furthermore, even if our package is used for transport, the telephone number printed on the label must be changed to that of the sender (customer).

Major Normative Reference

UN (United Nations) Recommendations (Air, Marine, Overland transportation)

- UN (United Nations) Recommendations on the Transport of Dangerous Goods: Model Regulations 18th revised edition
- UN (United Nations) Recommendations on the Transport of Dangerous Goods: Manual of Test and Criteria 5th revised edition, Amendment 2

Air Transportation

- International Civil Aviation Organization (ICAO): Technical Instructions for Safety Transport of Dangerous Goods by Air, 2015-2016 edition
- International Air Transport Association (IATA): Dangerous Goods Regulations, 56th edition 2015

Marine Transportation

- International Maritime Organization (IMO): International Maritime Dangerous Goods (IMDG) Code, 2012 edition (This is applicable until Dec. 31, 2015)
- International Maritime Organization (IMO): International Maritime Dangerous Goods (IMDG) Code, 2014 edition (This is applicable on and after Jan. 1, 2015 and will be mandatory on and after Jan. 1, 2016)

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